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INTERNATIONAL GEOPHYSICAL COOPERATION PROGRAM -- SOVIET-BLOC ACTIVITIES

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I. GENERAL

Academician Sedov New President of International Astronautical Federation

Academician Leonid I. Sedov, outstanding Soviet scientist in the field of space research, was elected president of the International Astronautical Federation during the organization's tenth congress, which was held in London recently.

Numerous reports on the basic problems of the development of space flight, the prospects of interplanetary travel, and of new engines utilizing nuclear energy and electromagnetic effects. The reports given by the Soviet delegation were received with particular attention. ("Academician Sedov -- president of the International Astronautical Federation"; Moscow, Pravda, 6 Sep 59)

II. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Mechta Now at Aphelion Says Soviet Scientist

Mechta, the first Soviet cosmic rocket, is now in its aphelion, according to V. Lutskiy, lecturer at the Moscow planetarium. During the 8 months since it was injected into orbit, the rocket has traveled more than 500 million kilometers and is now 197.2 kilometers from the Sun. Its speed is estimated 23.9 kilometers per second. The distance between the Earth and the new satellite of the Sun is now 120 million kilometers.

Lutskiy says, that despite the fact that no optical observations and radio contact exists, precise theoretical calculations of the rocket's movement, which was verified by radio signals in the initial part of the flight, and the photograph of the artificial comet [sodium cloud which was ejected at a point 113,000 kilometers from the Earth on 3 January at 0356:20 hours Moscow time] made it possible to calculate its future course into interplanetary space.

Two weeks after its launching, on 14 January, the cosmic rocket was at perihelion, a distance of 146.4 million kilometers from the sun. The velocity of the rocket at this moment was at its greatest.

The closest approaches of the rocket to Earth will be in 1975, 2028, and 2044. During this time, according to Lutskiy, it will be possible to see and photograph the rocket using powerful astronomical instruments. ("Where Is the Soviet Satellite of the Sun Now?" by V. Lutskiy; Moscow, Izvestiya, 2 Sep 59, p 6)

US and Soviet Rocketry Compared

In an article entitled, "Propaganda and Fact," Milan Codr discusses and compares US and Soviet rocket technology and advances. He begins by ridiculing US efforts to recruit all available scientists and engineers ..." right after they pass their final examinations," and mentions that despite the billions on billions of dollars expended and the "bombastic" advertising campaigns by large missile and aircraft manufacturers,... the desired results are not forthcoming."

Regarding the Soviet Union, Codr states that it is an open secret that the USSR is also working on the problem of re-entry. According to the author, the USSR is seriously considering plans for orbiting a manned space vehicle, although the methods used in the USSR differ considerably from those applied in the US. The author stresses that whereas the space

program in the US is characterized by a hurried and nervous pace, the USSR is calmly progressing to more complicated experimentation, even though it does not perhaps launch test vehicles every week.

Briefly reviewing the history of rocket development, Codr mentions that the US launched a Wac Corporal as early as May 1946 to a height of 389 kilometers with a payload of 12 kilograms. Russia did not launch a similar vehicle until 3 years later. The Soviet rocket reached a height of only 110 kilometers, but its payload was ten times greater than that of the Wac Corporal. Codr then stresses that on 21 February 1958, a Soviet single-stage geophysical rocket attained an altitude of 473 kilometers with a payload of 1,520 kilograms, a record which has thus far not been equaled by the US.

In reviewing Soviet experiments with animal-occupied rockets, the 27 August 1958 launching, in which a rocket carrying two dogs reached a height of 450 kilometers is mentioned. At this height, the lack of air pressure roughly corresponds to interplanetary conditions. The dog-carrying capsule, which also carried instrumentation, weighed 1,690 kilograms. The capacity of the rocket was close to that which might be required to accommodate a man in space.

US experiments in the same field are discussed, as are also the 2 and 10 July 1959 launchings of the animal-bearing Soviet geophysical rockets.

Codr says that it is obvious, from the facts he has presented, that the Americans lack the necessary rocket hardware to hoist a significant payload into space, without which the placing of a man in space is unthinkable. In referring to the US space program, which calls for the development of more sophisticated rocketry, from the Scout to the Nova, he states that the USSR is far ahead, both in the matter of payload, as well as in the optimum altitudes attained thus far. He states categorically the Soviets have, today, such rockets which enable man to enter outer space, a fact which was merely confirmed by the 2 and 10 July 1959 launchings. ("Propaganda and Fact," by Milan Codr; Prague, Zapisnik, 24 Jul 59, pp 16-17)

III. UPPER ATMOSPHERE

Soviets Finally Credit Van Allen Discovery

This article on the use of artificial satellites and cosmic rockets for the study of cosmic space gives the following information:

Perhaps the most interesting and unexpected result of scientific research with the aid of satellites and rockets up to now, is the discovery of two zones of high-intensity charged particles located at distances of 1,000 and 10,000 kilometers from the surface of the earth.

The controlling factor in the formation of these zones has been the magnetic field of the earth. If a charged particle with low energy enters the magnetic field of the earth, represented by the field of a dipole in the first approximation, such a particle, possessing a certain initial velocity, begins to move within the magnetic field in a helical path along the lines of force. The conservation of the magnetic moment of the particle leads to its movement along the line of force in accordance with the law $\sin^2 \theta/H = \text{const}$, where θ is the angle between the velocity vector of the particle and the intensity vector of the magnetic field H at a given point of the trajectory. As the particle moves along the lines of force, it enters the region of greatest geomagnetic latitude and, at the same time, approaches the earth. During this time, the intensity (H) of the magnetic field of the earth increases, and, since the $\sin^2 \theta$ value is limited, the particle is reflected and begins to move in the opposite direction along the same line of force.

Thus the magnetic field of the earth represents for charged particles a peculiar type of trap. Once captured in this trap, the particles begin to move along a fixed trajectory. Thus, with a relatively low intensity of particle injection in the trap, the trap can have a high energy density around it. In principle, this very process is being employed at present under laboratory conditions by physicists working on controlled thermonuclear reactions.

The intensity of flows of particles within the trap is determined by the force of the injection and the lifetime of the particles. Because of the low density of the atmosphere at great altitudes, the magnetic moment of the particles cannot remain constant, since energy is lost during collisions. For this reason, the charged particle which falls into the magnetic trap undergoes a considerable, although limited, number of oscillations. The limitation on the number of oscillations of the particles in the magnetic trap may be caused not only by the interaction of particles with matter in the atmosphere, but also by the fact that the nonstationary character of the magnetic field makes possible the

existence of electrical fields. At present, it is very difficult to account for the influence of all the real factors on the life time of a particle in the magnetic field of the earth.

There is no doubt, however, that the zones of high intensity, discovered with the aid of satellites and cosmic rockets, represent flows of charged particles captured by the magnetic field of the earth. This is indicated by the localization of these flows within a portion of space which is limited on all sides. S. N. Vernov named this phenomenon "terrestrial corpuscular radiation."

Since the motion within the magnetic field is along the lines of force, the configuration of the zone of terrestrial corpuscular radiation should be determined by the magnetic field of the earth, and zones of high intensity should have boundaries described by the lines of force of the magnetic field.

The fact that, within the magnetic field of the earth, two zones of terrestrial corpuscular radiation, an outer and an inner belt, have been formed is connected, apparently, with the existence of several different mechanisms of particle injection.

The first experimental indication of the existence of high-intensity charged particles at great heights was obtained by Van Allen during the flights of the US satellites Alpha and Gamma [Explorer I & III, 1958 Alpha & 1958 Gamma]. As we now understand, the high intensity observed in these experiments was connected with the entrance of the satellites into the inner zone.

The first data on the existence of two zones was obtained with the aid of Sputnik III. Instruments installed in the sputnik recorded an increase in the counting rate and ionization during the flight of the sputnik at approximately 55 degrees north latitude and 55 degrees south latitude. The altitude of the flight path of the sputnik in the northern hemisphere changed from about 250 kilometers to 550 kilometers, and was equal to about 1,600 kilometers in the southern hemisphere.

The systematic increase of ionization in these regions was a consequence of the sputnik's crossing the boundary of the outer zone. Since the inner boundary of this zone at the surface of the earth is limited approximately by the 55th geomagnetic parallels, the inner boundary of the outer zone in the equatorial plane is 20,000 kilometers from the center of the earth.

With the aid of instruments in Sputnik III, a systematic increase of ionization was also detected during the flight of the sputnik in the equatorial region. A sample recording of the scintillation counter data by the diesel-electric ship "Ob" in the region of South America shows that during the flight of the sputnik at about 45 degrees south latitude (about 35

degrees geomagnetic south latitude), the ionization in the crystal amounts to 10^{12}-10^{13} electron volts per second at an altitude of about 800-1,000 kilometers and about 1,800 kilometers. When the sputnik was flying in the direction of the South Pole, the ionization began to drop to about 10^{10} electron volts per second at about 55 degrees south latitude then followed a certain increase, which was connected with the entrance of the sputnik during its further flight into the outer zone of high intensity. Repeated recordings show that the outer zone and the equatorial or inner zone of high intensity are separated from one another by a region in which the intensity of the particles is considerably less than that inside each zone.

From data obtained with Sputnik III, it follows that the outer boundary of the inner zone follows the magnetic lines of force which interest the surface of the earth at a geomagnetic latitude of approximately 40 degrees. This means that the outer boundary of the inner zone in the equatorial plane is 10,000-15,000 kilometers from the center of the earth.

The instrument recordings of Sputnik III refer to a narrow latitude interval in the trajectory of the satellite (region of South America). There was no evidence of any marked dependence of intensity on longitude in the zone 35-38 degrees west longitude in the equatorial region.

As a result of the study of the dependence of energy emission, in the middle latitudes, on the longitude of the intersection of the equator by the sputnik, the maximum intensity in the equatorial zone was observed in the region of South America, and the minimum over Australia. This result was confirmed by the direct measurements of Van Allen which were made on the US satellite 1958 Epsilon. According to the data of this satellite, the lower limit of the equatorial belt is at an altitude of about 500 kilometers in the western hemisphere and about 1,500 kilometers in the eastern hemisphere.

The discovered dependence of the height of the lower boundary of the equatorial zone on longitude may be explained as a displacement of a magnetic dipole of about 500 kilometers in relation to the center of the earth.

It is clear that a further study of the terrestrial corpuscular radiation may give important information on the magnetic field of the earth at great altitudes.

No less interesting is the explanation of the nature and energy spectrum of particles which are captured in the magnetic trap. The study of this question, in any case, is necessary for an explanation of the injection mechanism.

Data from Sputnik III indicate the existence in the inner belt of protons with energies of approximately 100 million electron volts. A flow of these particles would comprise approximately 100 particles per square centimeter second steradian. On the other hand, according to data of the US satellite Epsilon, it is possible to draw conclusions on the presence in the equatorial zone of a soft radiation also. Even though the nature of this soft radiation is not known now, the proton component, in all probability, is formed as a result of the decay of neutrons which have formed in the earth's atmosphere under the influence of cosmic rays. The neutron mechanism of injection of charged particles in the magnetic field of the earth was suggested by S. N. Vernov and A. I. Lebedinskiy.

According to Sputnik III data, proton flows in the inner belt are quite stable, as should be expected from the neutron theory of injection. In fact, the origin of injection is constant with respect to time, and a particle life time on the order of one year would be required to explain the observed intensity.

Evidently, a completely different mechanism of injection is responsible for the creation of the outer belt. From Sputnik III data, it was learned that the radiation of the outer belt consists of electrons with energies of about 100 kiloelectron-volts. It was discovered that the number of these electrons is subject to great fluctuation. More detailed data on the outer belt were obtained with the aid of a Soviet cosmic rocket. The complete energy emission in the crystal 40 x 40 x 40 millimeters), measured by a scintillation counter shielded from outer space by an aluminum coating about one gram per square centimeter thick, was plotted. The intensity of the particles in the outer belt depends considerably on distance, and has its maximum at an altitude of 26,000 kilometers from the center of the earth.

The result of the measurements of intensity of particles in the outer belt obtained with the Soviet cosmic rocket can be compared with data obtained with the US Pioneer III. The trajectory of these rockets during departure from the earth and during approach to the earth is illustrated, and curves are plotted for the rate of counting of the Geiger counter installed in the US satellite. The effective area of the counter was 0.75 square centimeters. The counter was shielded from outer space by a layer of material about one gram per square centimeter.

As can be seen from a comparison of the curves, the maximum intensity determined by both Soviet and US rockets is found at several different distances. Such a deposition of intensity maxima may be explained with several reasons, including the different spectral sensitivity of the instruments. It should also be remembered that the flight of the rockets occurred at different times, and the maximum intensities of the instruments in the rocket were established in different hemispheres.

The curves show a characteristic presence of a minimum, or plateau, at distances of 10,000-15,000 kilometers, which indicates that the trajectories of the rockets at distances of 10,000-15,000 kilometers either left or approached the boundaries of the outer belt.

The apparatus installed in the Soviet rocket contained several detectors with different spectral sensitivity, including two scintillation counters, under various thicknesses of material, which recorded the number of particles of various energies and the complete energy emission in a crystal.

The instruments in the Soviet rocket confirmed the presence in the outer belt of electrons with energies of 20-100 kev, and established that the spectrum of charged particles does not remain constant at various distances. In the center of the outer belt the spectrum of particles becomes softer: The value of the effective energy at maximum intensity amounts to about 25 kiloelectron-volts, where as at the edges of the belt, it is about 50 kiloelectron-volts.

Artificial satellites and cosmic rockets have established the presence of two different zones of terrestrial corpuscular radiation which differ not only in position in space but also in particle composition.

The inner and outer belts differ also in origin. Whereas the inner belt owes its origin to a neutron mechanism of injection, the outer belt is formed by the invasion of the magnetic field of the earth by flows of particles emitted by the sun. ("Terrestrial Corpuscular Radiation," by A. Ye. Chudakov and Ye. V. Gorchakov, Moscow State University; Moscow, Priroda, No 8, Aug 59, pp 86-89)

New Interference-Polarization Filter Developed for Chromosphere Observations

The use of interference polarization filters to observe the chromosphere at the disk and edge of the Sun has become quite widespread. The network of astronomical observatories of the Sun service in USSR was equipped with special chromosphere telescopes based on the use of these filters with a very narrow transmission band. The observations were systematically published in the journal Solnechnyye Danyye (Solar Data) in the form of tables and daily maps.

The use of these filters in conjunction with powerful solar telescopes makes it possible to obtain new and valuable material on the fine structure of the chromosphere and prominences and on movements in them.

More widespread is the use of these filters in the H_α line of hydrogen. However, observations in the K-line of ionized calcium would be no less important. Unfortunately, difficulties arising in making such a filter with a very narrow transmission band for this region of the spectrum

made it impossible to develop filters of the required characteristics. The film polarizers which have recently appeared provided the prerequisites for the development of the necessary filter. The relatively small length of the light wave and unfortunate increase in the index of double-ray refraction in quartz and Iceland spar greatly complicated the problem. The filter for the K-line of ionized calcium developed at the Institute of Crystallography, Academy of Sciences USSR, made it possible to observe only intense calcium prominences on the edge of the disk. The photographs with the article showed the image of the Sun's disk covered by a diaphragm.

A filter prepared at Harvard Observatory, has a wide transmission band of 4 angstroms and can obviously be used to observe only prominences. In the article describing the filter, no experimental material was given.

S. B. Ioffe and N. M. Drichko have developed a new filter for the K-line of ionized calcium. It has a transmission band about 0.5 angstroms wide. The method used in its preparation made it possible to obtain a filter with high optical characteristics. The polaroids used were films of the same type as in the filter of the Institute of Crystallography.

Trial/observations with our 0.5-angstrom filter were made at Pulkovo from 20-24 March 1959, using a horizontal solar telescope. The picture obtained had high contrast and was rich in detail and showed calcium formations in the KCa^+ line at various points on the Sun's disk and at the edge.

The filter was placed directly at the focus of the instrument in front of the focal plane. The beam was diaphragmed up to 20 centimeters, corresponding to a relative aperture of 1 : 70 for a focal distance of 17.5 meters. The diameter of the image of the Sun was 16 centimeters. The filter operated at a temperature of 37.2 degrees and was centered on the center of the KCa^+-line. Figure 1 [not reproduced here] shows a picture of the prominence and chromosphere at the edge obtained on 21 March 59. The exposure on a PF-3 film was one second. The disk of the Sun was not diaphragmed.

Figure 2 [not reproduced here] shows a picture of chromosphere formations visible in the K-line on the disk of the Sun close to the edge. The picture was taken on 21 March during exposure of 0.1 seconds. There is high contrast between the light flocculi.

Figure 3 [not reproduced here] (the picture was taken 23 March with an exposure of 0.1 seconds) shows flocculi close to the center of the disk. Despite the fact that on the indicated days the sky was covered with weak cirrus clouds and the quality of the image was poor, the flocculi showed up with high contrast, indicating the high quality of the filter and the small quantity of scattered light in it. These first trial

observations with the filter for the KCa^{+}-line indicated that these filters may be successfully applied in the net of the Sun service in chromosphere telescopes along with filters for the N -line, which is already widely used by the Sun service.

The new filter for the KCa^{+}-line may be used in conjunction with large Solar telescopes for investigations of the fine structure of the chromosphere, both on the disk of the Sun and at the edge and also for the study of motion in the prominences.

The authors wish to express their appreciation to Academician V. P. Linnik for his interest in the work. ("Observation of the Chromosphere on the Disk at the Edge of the Sun in the Radiation of the K-Line of Ionized Calcium With the Aid of an Interference-Polarization Filter," by S. B. Ioffe, N. M. Drichko, I. A. Prokof'yeva, and V. M. Sobolev; Moscow, Doklady Akademii Nauk SSSR, Vol 127, No 4, 1 Aug 59, pp 796-797)

New Astrophysical Observatory in Azerbaydzhan

The largest astrophysical observatory in Azerbaydzhan is being built in the mountains near Shemaka. Research in solar physics and astrophysics will be conducted here. The optical equipment will be located in three high turrets over the main building. Part of the instruments for determining the position of stars will be placed on the summit of a neighboring mountain at an altitude of about 2,000 meters. Living quarters for the observatory's personnel will be built near the scientific area. ("Observatory of the Sun"; Moscow, Pravda, 6 Sep 59, p 6)

IV. METEOROLOGY

Prognosis of Cyclo- and Anticyclogeneses

The prognostic possibilities of barotropic systems have been extensively studied. As is known, the hypothesis of barotropicity enables one to obtain a system of hydrothermodynamic equations in quasigeostrop ic and quasistatistic approximations to the following equation in the stand-ard system of coordinates:

$$\Delta \frac{\partial z}{\partial t} = - \frac{g}{j} (z, \Delta z) - \beta \frac{\partial z}{\partial x}, \qquad (1)$$

where z is the altitude of the isobaric surface, g is the acceleration due to gravity, j is the Coriolis parameter, $\beta = \frac{\partial j}{\partial y}$;

$$\Delta = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2};$$

$$(a,b) = \frac{\partial a}{\partial x} \frac{\partial b}{\partial y} - \frac{\partial a}{\partial y} \frac{\partial b}{\partial x}.$$

Equation (1) is approximately achieved on some mean level which is identified with a surface of 700 or 500 millibars. A large number of prognostic systems for the precalculation of baric fields at a mean level with the help of computers have been developed on the basis of the equation in question in the USSR as well as in foreign countries. These systems differ from each other by the application of a different method of solving equation (1) relative to $\frac{\partial z}{\partial t}$ (method of Green functions, iterations and etc.

The voluminous material of experimental and operative prognoses at hand demonstrates the following: in a series of cases daily barotropic prognoses of a baric field at a mean level have high reliability. Correlation coefficients between the prognostic and actual daily tendencies attain values between 0.8 and 0.9. Nevertheless, a sufficiently large variability of the correlation coefficient is observed from case to case. It would have been possible to present examples when it lies between 0.1 and 0.2 or is even negative. Special analysis indicates that unsatisfactory prognoses are observed during baroclinic reorganization and intensive evolution of the baric field at the mean level. Nevertheless,

in barotropic systems the displacement of baric objects is predicted with some lag. All this impelled many investigations in the region of numerical prognoses to turn attention on obtaining prognostic systems taking into account the three dimensional baroclinic structure of the atmosphere. Systems of that type have been correctly developed abroad, as a rule with the added condition that the system be polytropic. More exact solutions for the equations of hydrodynamics of the atmosphere have been obtained in the Soviet Union, on the basis of which, a series of prognostic models have been successfully constructed (Belousov S. L., "Concerning the precalculation of pressure at different levels," Meteorologiya i Gidrologiya, No 9, 1957; Mashkovich S. L., "Prognosis of pressure with the help of computers," Meteorologiya i Gidrologiya, No 1, 1957; and Yudin M. I., "Concerning the prognosis of pressure by numerical methods," Trudy GGO, No 71, 1957).

In the present work on the basis of nummerical prognosis of a baric field at several levels the integral solution of N. I. Buleyev and G. I. Marchuka is given as follows:

$$\frac{\partial z}{\partial t}(0,0\zeta) = \frac{1}{2\pi}\int_0^1 \int_0^\infty \int_0^{2} m^2 \frac{j}{g} A_\Omega(\eta, r, \varphi) M_1(\zeta, \eta, r)\, r\,dr\,d\varphi\,d\eta + \\ + \frac{1}{2\pi}\int_0^1 \int_0^\infty \int_0^{2\pi} \frac{R}{g} A_T(\eta, r, \varphi) M_2(\zeta, \eta, r)\, r\,dr\,d\varphi\,d\eta, \quad (2)$$

where $\zeta = \frac{p}{p_0}$ is the reduced pressure; p_0 = 1,000 millibars; T is the temperature on the absolute scale; R is the specific gas constant of dry air; $m^2 = R^2 \bar{T}(\gamma_a - \bar{\gamma})/gj^2$, the superscript designating the mean value at the limits of the troposphere; γ_a, γ are the dryadiabatic and actual vertical gradients of the temperature respectively; $A_\Omega = g^2/j^2(z, \Delta z) + \beta g/j\ \partial z/\partial$ is the dynamic and $A_T = -g/j\ (z,T)$ is the thermic factors; $M_1(\zeta, \eta, r)$ and $M_2(\zeta, \eta, r)$ are functions of the action.

The values of the functions M_1 and M_2 are computed over a wide range of fluctuation of their arguments and are the nummerical basis during the construction of the prognostic system for the precalculation of z at several layers. However, upon comparison with the initial variation proposed here the nummerical system underwent several alterations.

Solution (2) applied to the daily pronosis of maps of the absolute baric topography of 850, 500 and 300 millibars is approximated by sums; moreover, integration with respect to the verticle η is performed by the method of trapezoids, and in the horizontal r, φ plane according to rings:

$$\left(\frac{\partial z}{\partial t}\right)_i = \sum_{s=1}^{3}\sum_{k=1}^{3} a_{i,s,k}\,\bar{A}_{\Omega;s,k} + \sum_{s=1}^{3}\sum_{n=1}^{2} b_{i,s,n}\,\bar{A}_{T;s,n}, \qquad (3)$$

here i is the index of the predicted level, corresponding to ζ ; k is the index of the actting level corresponding to η; s is the number of rings, n is the number of the actting layer (850-500 millibars, 500-300 millibars); A_Ω and A_T are the averaged dynamic and thermic factors according to the area of the rings, represented by finite central differences with the grid of differentiation 500 kilometers; $a_{i,s,k}$ and $b_{i,s,n}$ are the weight multipliers.

The method in brief consists of the following. According to the known initial field z at the moment t at three levels A_Ω and A_T are determined in finite-difference form and after averaging of the determined quantities according to the rings, the summation (3) is performed. Assuming that the obtained instantaneous variation of the geopotential according to time in some small interval Δt is constant, the linear exstrapolation

$$z(t+t) = z(t) + \frac{\partial z}{\partial t}(t)\,\Delta t \qquad (4)$$

is employed for the determination of z. Thereafter calculations are repeated by grids according to time at the date of prognosis.

The initial field z is given at junctions of a rectangular net (24 x 20 junctions) having square cells the sides of which equal 250 km. At the boundaries of the indicated region invariability of z is tolerated in the course of the entire date of prognosis (one day). We note that the solution (2) is found for the surface of the Earth which is simply represented by an infinite extending surface. For practical calculations it is necessary to replace the integrals in (2) having infinite limits by the finite sum (3). From the physical point of view such a replacement means that the solution at a particular point is determined only by the influence of the dynamic and thermic factors of the neighboring bounded region. In the reduced system of solution the outer radius of periphery of the indicated region with center at the point of prognosis is somewhat greater than 900 kilometers.

In connection with the fact that the differential operators (A_Ω and A_T) are approximated by finite differences and their summation is conducted according to the area, the region of the precalculated values is somewhat shortened. As an example prognosis of the baric field according to the indicated method requires one hour on the computer "Strela."

Analysis of a series of numerical baroclinic prognoses indicate that according to quality they are better than barotropic prognoses on the corresponding level. Calculation of the three-dimensional baroclinic structure of the atmosphere in a three level model enables one to liquidate the existing insufficiency of the two-dimensional prognoses. Displacement of the baric evolutions according to the baroclinic system is predicted significantly more accurately. The following important case is noted. As far as is known, only one example of prognosis of cyclogenesis appears in meteorological literature (Charney, I. G., "Numerical prediction of cyclogenesis", Proceeding Nat. Acad. of Sciences USA, No 40(2), 1954). Study of a series of nummerical prognoses according to the system considered above, (3), indicates that it correctly provides the possibility to predict cyclo- and anticyclogeneses. ("Prognosis of Cyclo- and Anticyclogeneses with the Help of a Computer," by P. K. Dushkin, Ye. G. Lomonosov and M. S. Tatarskaya; Meteorologia i Gidrologiya, No 6, 1959, pp 11-16)

Hungarians Establish Meteorological Station in Mecsek Range

Construction of Hungary's first high-altitude weather and climate research observatory is nearing completion on the 534-meter-high Misina Peak (Misinateto) near Pecs. The observatory, built largely from social actions [i.e., with volunteer labor] has the most modern equipment and is supremely suitable for observing the climate of the Mecsek range. It can also give data on the entire Trans-Danubian region.

The Mecsek Observatory has already begun partial operations and later, in addition to data sent to the Meteorological Institute, it will also give reports to local agriculture. ("Mecsek Observatory Begins Operation," Budapest, Magyar Nemzet, 11 Aug 59, p 6)

V. OCEANOGRAPHY

New Soviet Weather Ship Sails on First Voyage

The new scientific research expeditionary ship A. I. Voyeykov sailed from Odessa for Vladivostok on 4 September. This ship was built at the Nikolayevskiy Plant imeni Nosenko on order of the Main Administration of the Hydrometeorological Service under the Council of Ministers USSR. An interview with a Pravda correspondent given by K. T. Logvinov, deputy chief of the administration, gives the following information.

The new ship, which bears the name of the famous Russian climatologist and traveler, has no equal in the world as to equipment and construction. With it, a wide complex of scientific research works and hyderometeorological observations in the vast reaches of the ocean are possible.

The A. I. Voyeykov is a scientific weather ship in the full sense of the word. It has a water displacement of 3,600 tons, the length of its hull is 84.5 meters, and its main engine develops 2,000 horsepower. It is capable of voyages lasting up to 3 1/2 months and traveling up to 15,000 nautical miles without making port.

The ship is equipped with the most modern scientific equipment. Thirty-eight laboratories and production-technical shops in which the latest instruments of native design are installed are arranged throughout the ship. For meteorological observations at several levels above the surface of the ocean, a special mast is carried on board. A special apparatus is installed on an independently floating buoy these same purposes. Six hydrological electric winches on board make it possible to study even the maximum depths of the ocean. In regard to the upper layer of the atmosphere, a whole complex of scientific equipment and instruments, with the aid of which an extensive program for sounding the atmosphere up to great altitudes can be realized, is carried aboard the ship.

Observations from the ship will be transmitted by radio and included in a general weather summary. These data can be used by synopticists the world over.

On its first voyage from Odessa to Vladivostok, the A. I. Voyeykov will sail, on the whole, about 14,000 nautical miles. After replenishing its stores in Vladivostok, the ship will sail into the Pacific where systematic investigations according to the full program will begin.

For continuous observations and investigations at sea, it is obvious that still another ship is needed. For this reason, a second similar ship, is being built. This ship will be named after the world-famous oceanographer Academician Yu. M. Shokal'skiy. ("Weather Ship"; Moscow, Pravda, 4 Sep 59, p 6)

Soviet Scientist Discusses USSR Oceanographic Research

Investigations of the world ocean have expanded enormously in recent years. They are of paramount value for many fields of Man's activity, especially for studying the climate of our planet, forecasting the weather, the safety of navigation, fishing enterprises, and so forth.

Oceanography and marine sciences have acquired wide development in the Soviet Union. Investigations by Soviet scientists now embrace all the world ocean from the circumpolar regions of the North Arctic Ocean down to the continent of Antarctica. A brief review follows of these studies being conducted by the USSR, as given in an interview by Prof L. A. Zankevich, Corresponding Member of the Academy of Sciences USSR, chairman of the Interdepartmental Oceanographic Commission Under the Academy of Sciences USSR.

The period of the IGY was a most notable one for oceanographers. In the course of the investigations conducted under this program, all areas of the world ocean were studied simultaneously by many countries on an enormous scale. More than 20 Soviet expeditions were engaged in this work. On the whole, these covered over 270,000 miles and performed 2,500 oceanographic stations. The total work performed by Soviet scientists was almost double that of US scientists.

Outstanding work on the study of the ocean depths in the northern, central, and partially in the southern parts of the Pacific Ocean was carried out by the Vityaz. Many previously unknown submarine ridges were discovered, and the northern portion of the meridional Pacific ridge in particular was studied. Detailed studies of the principal deep-water trenches of the Pacific led to the discovery of the greatest depth yet found, 11,034 meters in the Mariana Trench.

Specially designed trawls enabled scientists aboard the Vityaz to discover over 200 types of different fish, among them deep-water fish earlier unknown to science.

Extensive investigations in south polar waters were conducted by the special ice-breakers, the ships Ob' and Lena. New capes, mountains, glaciers, and submarine ridges were discovered. To the east of Antarctica, a deep-water trench between the Davis and Ross Seas was traced for more than 2,000 miles.

Next, in turn, to be studied, will be the Indian Ocean, that great expanse of waters washing the shores of four continents. This is the task set before the Vityaz. At the end of September, this ship will leave Vladivostok on its first voyage in this ocean. The expedition will include in its investigations the enormous region in the northern part of the Indian Ocean from the Sunda Island archipelago to the shores of Africa. Here, unknown submarine ridges, trenches, and depressions may be discovered. West of the Island of Java lies the Java depression which will also be studied. In the Persian Gulf, the Red and Arabian seas, where the waters have a high content of salt, scientists will endeavor to explain the reasons for the death of masses of fish running into the millions of tons.

The Vityaz' first voyage in the Indian Ocean will last about 6 months. A second voyage in the Indian Ocean by the expedition will be made in 1960.

Unique observations were conducted during the IGY by the Zarya, only nonmagnetic scientific research ship in the world. The Zarya recently left on its second voyage. Scientists aboard will study the Earth's magnetic field and its secular variations in areas of the Indian Ocean and the western part of the Pacific. The ship will travel more than 30,000 miles and be for a while near the shores of India, Indonesia, Australia, New Zealand, the islands of Samoa and Fiji, Japan, and the People's Republic of China.

Expeditions of the scientific research institutes of the fish economy are operating in many seas and oceans. In Far Easter waters, they are studying the reserves of whales. The raw material resources of the Atlantic are also being investigated.

The expeditionary ships Akademik Kovalevskiy and Akademik Vavilov of the Academy of Sciences USSR are now operating in the Mediterranean Sea. The study of animal organisms populating the deep waters of the Mediterranean Sea and the establishment of means for their passage into the Black Sea is of great interest.

The four-masted expeditionary sailing ship Sedov is now in the Atlantic. Many scientists of various specialties are on board.

The expeditionary ship Mikhail Lomonosov has already conducted hydrophysical and oceanographical investigations in the Atlantic for 2 years. At present, it is again on a voyage. Profiles of almost 1,000 miles have been made from the Azores to the Grand Banks off Newfoundland. For the future, the Mikhail Lomonosov will make a number of interesting crossings of the Atlantic.

The Mikhail Lomonosov is now in the port of New York. It is the first Soviet scientific research ship to enter that port. Many of the associates of the expedition have been invited to take part in the work of the First International Oceanographic Congress which opens on 31 August in New York.

Among the many subjects which will be discussed at the congress are the problems of the circulation of the waters in the world ocean, the study of the ocean depths, bottom relief, depositions, and also biological productivity.

Recently, the proposal to dispose of radioactive wastes in the oceans, in particular in the trenches, the depths of which, in several cases, exceed 10 kilometers, has been made outside the Soviet Union. This proposal is based on the hypothesis that in the deep-water trenches there are stagnant waters. But there are no stagnant regions in the world ocean. Even in the deepest depressions the waters are in a state of rather rapid circulation.

A very important phenomenon is the "biocirculation." Enormous masses of animal organisms do not remain in one and the same region of the sea. Fish and squid, for example, make rapid and lengthy trips through extensive reaches of the oceans. Plankton organisms migrate in a vertical direction. These organisms, constantly moving on a grand scale, having obtained a radioactive charge in one part of the ocean can convey it into any other distant region. This means that it is impossible to keep radioactive wastes in the deep-water tranches. ("In the Space of the World Ocean"; Moscow, Pravda, 30 Aug 59, p 6)

VI. SEISMOLOGY

Conference on Seismic Research at Pulkovo

A conference devoted to the results of scientific research work performed at the Central Seismic Station during 1957-1958 was held at Pulkovo from 10 to 14 February 1959. A joint program of work for the study of surface waves in 1959 and other problems was also discussed.

Scientific associates of Pulkovo Station, the Insitute of the Physics of the Earth of the Academy of Sciences USSR, the Simferopol' Station, Moscow State University, the Institute of Geophysics of the Academy of Sciences Georgian SSR, and the Institute of Geology Academy of Sciences Azerbaydzhan SSR took part in the conference.

An account of the work of the Pulkovo Station in the Arctic zone during 1957-1958 was given by A. P. Lazareva (Pulkovo).

Work on installing all the station apparatus and putting them into operation was begun in 1956 after completing the rebuilding of the superstructure, which was destroyed during World War II. After determination of the spectrum and the noise level (1957), the apparatus for selecting the optimal characteristics for recording a wider range of seismic oscillations and departing from the field of high-frequency disturbances which distort the recording of earthquakes was returned. The set of D. P. Kirnos instruments were designed principally for the registration of long waves. The maximum sensitivity was shifted to the region of periods with T = 25 seconds. Only three pendulums, adjusted to different characteristics embracing both long and short periods, were hung from the azimuth apparatus. In 1958, a vertical Kirnos Seismograph (SVK) the resistances of the working coil were 7,000 ohms. There is an amplification of $\sim$7,000 times with a sharp maximum at T $\approx$ 1 second. B. B. Golitsyn seismographs have standard characteristic. The presence of such apparatus led to a considerable increase in the number of earthquakes recorded.

The work of the station, central for the Arctic zone, was directed in the compilation of a preliminary bulletin of earthquakes in the Arctic zone. During 1958, 152 shocks were recorded in the Arctic zone.

A report by T. V. Matorina dwelt on the problem of instrumental observations at the Pulkovo seismic station. The state of the different apparatus with which the station is equipped was described, and an account of a study on the applicability of apparatus with different frequency characteristics was given.

Work on expanding the range of oscillations being recorded in the long wave field is also being continued and, at present, in the aim of creating more long-period apparatus with $T_1 = 40$ seconds and $T_2 = 50$-60 seconds. The report was illustrated with notes on instruments with different frequency characteristics.

In 1958, a signal system for strong earthquakes was designed and installed and a new power unit for the existing signaling apparatus was designed and installed. A system for the reception and introduction of time signals from the Main Astronomical Observatory of the Academy of Sciences USSR on seismograms was also set up, with provisions for switching-in a chronometer in case of a disruption in the observatory time service.

A tripartite microseismic station has been operating at Pulkovo since 1955. A system for amplifying microseisms by a factor of ten with a small noise background is now being installed.

The study of surface waves is an important part of the work at Pulkovo.

A report by T. B. Yanovskaya concerned the theory of nonstationary surface waves. For investigating dispersing surface waves from a non-stationary source analytically, the displacements can be represented by the integral

$$\int_0^\infty F(w) e^{i[wt - k(w)r]}\, dw, \qquad (1)$$

which can be estimated approximately using the stationary phase method. However near the minimum of the group velocity, such an estimate is unsuitable and in this region, the integral is estimated according to Eyre's method. The regions for the applicability of the stationary method and Eyre's method do not overlap. Therefore, it is considered of interest to find such an asymptotic representation of the above integral (1) which would correct for any value of t, and consequently, would include both the result obtained by the stationary phase method for group velocities remote from the minimum group velocity, as well as the result obtained according to Eyre's method for velocities near the minimum group velocity. This has practical value as the maximum amplitudes of surface waves are mainly observed with velocities close to the minimum and investigations of dispersing curves of surface waves occur mainly in these parts of seismograms.

An asymptotic presentation of the integral (1) is given which is correct for any values of t, i.e., for any values of the group velocity C. It is expressed as an Eyre function. Theoretical seismograms for the given law of dispersion in the cases of different amplitude functions. It was shown that if the amplitude function is different from zero up to the frequencies of both greater and smaller frequencies corresponding to the minimum of the group velocity, then the recording of the displacements takes on the form of pulses in which the period of the pulses depends on the nature of the amplitude of the function as well as on the nature of the dispersion. The dispersion curves of group velocities, plotted according to such seismograms by the usual methods, agree with actual dispersion curves.

A. P. Lazareva (Pulkovo), Ye. F. Savarenskiy and O. N. Solov'yeva (Moscow) reported on certain results of the investigations of experimental dispersion waves. The reporters informed the conference of the work begun on estimating the mean thickness of the Earth's crust in the region of Siberia according to data on the dispersion of surface waves, mainly from earthquakes in the Far East. In addition to this, records of earthquakes in the Atlantic Ocean were studied, and dispersion curves were plotted. It was noted that for these two different parts of the path, the dispersion curves differ considerably from each other. This qualitative difference in the curves indicates a considerable difference in the mean structure of the Earth's crust on the courses from Pulkovo to the Atlantic region and the Far East.

S. F. Oborina reported on the study of the structure of the Earth's crust in the Arctic according to observations on surface waves.

The Earth's crust in the Arctic basin has a very complex structure, and geophysical data of this region are scared. Therefore, with the aim of studying the thickness of the Earth's crust, the author began plotting and study of dispersion curves of the group velocities of Love and Rayleigh waves for courses passing through the Arctic. Recordings of the station in the Arctic zone, and mainly these of Pulkovo Station were used. The principal path was the region from Pulkovo to Alaska, crossing the deepest part of the North Arctic Ocean (a depth of up to 5,000 meters). For eight Alaskan earthquakes a dispersion curve of Rayleigh waves for periods of 15-42 seconds. A comparison of this curve with theoretical curves for the continent and the ocean reveals the clearly noncontinental structure of the Earth's crust in this region. Curves of the group velocities for Love waves for the range of periods from 20-48 seconds were constructed. There are in good agreement with data obtained by Gutenberg and Richter for the Atlantic and Indian Oceans.

In view of the very complex structure of the Earth's crust in the Arctic, the presence of the transition zone from the continent to the ocean, the complex bottom relief on the route of the waves, and changes in the depth of the water layer, it was necessary to construct theoretical curves calculated for the Arctic. The work was begun not long ago, and its results cannot be considered final.

The considerable amount of work conducted on the study of the seismicity and structure of the Earth's crust in the Arctic, on the investigation of the applicability apparatus with different frequency characteristics, and on the theory and interpretation of surface waves was noted by the conference after having discussed the reports of the scientific associates of the stations which were presented. The participants of the conference approved the introduction of the plan of scientific research works for Pulkovo Station for 1959, considering it necessary to direct the station's research work principally toward the study of surface waves, especially those of long periods.

The second half of the conference was devoted to a discussion of the joint program of work in 1959 on the study of surface waves.

After hearing the informative reports on the conduct of work and plans in 1959 on the study of surface waves in the departments of Seismology and the Seismic Service; of Mathematical Geophysics; of the Central Seismic stations Pulkovo, Moskva, and Simferopol' of the Institute of the Physics of the Earth Academy of Sciences USSR; in the Chair of the Earth's Crust Moscow State University; and in the academies of science of the Azerbaydzhan and Georgian SSRs, the participants at the conference noted that the work on the study of surface waves was considerably expanded. Various institutions, the number of which always increases, are beginning to take part in these studies. In this connection the conference approved the joint plan of work on the study of surface waves agreed on in the conference and asked the Council on Seismology to coordinate this area of seismic investigations in the future. (Full translation of article, "Conference Devoted to the Results of Scientific Research Work of the Central Seismic Station 'Pulkovo' and to Investigations on Surface Waves," by V. M. Arkhangel'skaya; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 7, Jul 59, pp 1,085-1,086)

Earthquake Reported in Lake Baykal Region

According to a 31 August dispatch from Irkutsk, a strong earthquake occurred in the Lake Baykal region at night on 30 August. Shocks were felt in Ulan-Ude, Irkutsk, and other points.

The epicenter, according to preliminary data, was located in the sparsely-populated southern shore of Lake Baykal, near the mouth of the Selenga River. The first shocks were registered at 0111 hours local time. The earthquake reached an intensity of 8-9 degrees of intensity at the epicenter. No destruction or deaths resulted. The last large-scale earthquake in the region of the Selenga River delta was noted on 12 January 1862 and reached an intensity of 9.

A strong earthquake was reported by Prof Ye. F. Savarenskiy, chairman of the Council on Seismolgy Academy of Sciences USSR and chief of the "Moskva" seismic station. According to Prof Savarenskiy, the quake was recorded on 29 August at 2011 hours Moscow time. The epicenter was fixed at a distance of 4,400 kilometers from Moscow on the eastern shore of Lake Baykal, in the region of the mouth of the Selenga River. According to the data of the Irkutsk station, more than 100 secondary shocks of lesser intensity were observed in the course of 24 hours.

Prof Savarenskiy noted that Lake Baykal is located in the zone of intensive tectonic processes, which, in this territory, manifest themselves in upheavals and subsidences of separate parts of the Earth's crust. These processes, said Prof Savarenskiy, take place in the course of definite epochs of the geological development of the Earth. They gradually give rise to internal tensions (compression, strain, and folds) in the Earth's crust. These elastic tensions cause fractures and breaks in the various parts of the crust, the formation of which is related to earthquakes. ("Earthquake in the Lake Baykal Region"; Moscow, 1 Sep 59, p 4)

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